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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/676,643

10/01/2003

Wan Shick Kim

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SALIWANCHIK LLOYD & SALIWANCHIK

A PROFESSIONAL ASSOCIATION

PO BOX 142950

GAINESVILLE, FL 32614-2950

EXAMINER

MULLER, BRYAN R

ART UNIT

PAPER NUMBER

3723

MAIL DATE

DELIVERY MODE

04/02/2008

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/676,643

**Applicant(s)**

KIM, WAN SHICK

**Examiner**

BRYAN R. MULLER

**Art Unit**

3723

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 29 January 2008.  
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 2, 3 and 5-8 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 2, 3 and 5-8 is/are rejected.  
7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
10) ☒ The drawing(s) filed on 01 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All b) ☐ Some \* c) ☐ None of:  
1. ☒ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☐ Information Disclosure Statement(s) (PTO/SB-08)  
Paper No(s)/Mail Date \_\_\_\_\_  
4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_  
5) ☐ Notice of Informal Patent Application  
6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 2, 3 and 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo et al (2002/0061722) in view of Kilham (5,191,388).
3. In reference to claim 2, Kondo discloses an apparatus to control slurry flow in a chemical mechanical polishing apparatus for planarizing an object to be polished by supplying slurry on a grinding pad through a slurry injection conduit, the apparatus comprising a slurry supply unit (10-3 and 42) to supply slurry to the slurry injection conduit (57) through a slurry supply line (56), a by-pass (561) diverged from the slurry line, wherein the slurry in the by-pass is returned to the slurry supply line, a photo image sensor (7) to detect a cross-sectional image of the slurry flowing in the by-pass, a slurry measuring unit (arithmetic processing unit; paragraph 48) to analyze the image captured by the photo image sensor to measure the sizes of particles included in the slurry and the density of the slurry across the cross-section of the by-pass (as seen in figure 2), a slurry flow control unit (10) to control the slurry supply unit based upon the particle sizes and the slurry density measured by the slurry measuring unit. Kondo also discloses that the solution as produced is sampled and diluted with pure water and then irradiated with light (paragraph 3, lines 1-4), which is provided at the point of the sensor,

because it is difficult to measure abrasive grains in some circumstances when a large amount of larger sized abrasive grains are present in the slurry (paragraph 3, lines 19-25). As discussed above, paragraph 3 of Kondo discloses that the solution is diluted after being removed from the main supply line and prior to passing through the sensor, thus it would have been obvious to one of ordinary skill in the art that a diluent solution would be provided to the by-pass (561) from a diluent solution supply unit in order to dilute the solution at a point between the main supply line and the sensor. Additionally, it would have been obvious to provide the diluent solution supply unit directly to the by-pass because a smaller amount of diluent solution would need to be added to the slurry solution in the by-pass than would need to be added to the slurry solution in the slurry supply line to sufficiently dilute the slurry solution that is passing through the sensor to desired amount. However, Kondo fails to specifically disclose a slurry injection nozzle, but does disclose that the slurry is supplied to the work piece of a CMP tool, and it is commonly known in the art that a nozzle may be used to supply slurry to a work piece accurately during the CMP process. Therefore, it would be obvious to one of ordinary skill in the art at the time the invention was made to provide a nozzle to supply the slurry to the substrate in order to control the slurry and make application of the slurry more accurate. The sensor disclosed by Kondo provides a light source to one side of the by pass, and detects the amount of light that is irradiated through to the other side, which is clearly collecting data based on the cross section of the by-pass that the light is passing through, and Kondo discloses that the sensor is used to detect the number of large abrasive grains contained in the polishing solution. Thus, the sensor is distinguishing

between large and small particles and determining the number of said large particles in the solution, thus by determining the number of large particles in the cross-section that is being detected based on the light that passes through the cross-section of the by-pass, the sensor is inherently detecting some form of image of the cross-section that is analyzed to determine the sizes of the particles (determining the number of particles above a certain size) and by determining the number of particles in the solution, is inherently determining the density of the particles in the solution. Although the sensor disclosed by Kondo may be considered to be a photo image sensor, Kondo further fails to disclose that a display unit is provided to display the sizes of particles included in the selected cross-sectional image and a particle density of the slurry across a cross-section of the by-pass. Kilham discloses an apparatus for detecting and analyzing particulate matter in a slurry flow, which comprises an optical transmission means for viewing an image of the particulate matter (particles) in the thin layer that may be 3-dimensional (cross-section) of a slurry flow, which is connected to a video camera for receiving the image of the particulate matter in the thin layer of the slurry flow (Col. 2, lines 61-67), thus the optical transmission means along with the video camera may be considered to be a photo image sensor. Kilham further discloses that the image detected by the photo image sensor may be enhanced by a computer and analyzed to determine particle size, type and quantity in the slurry (Col. 3, lines 3-8; detection of size and quantity in the slurry is essentially the same as detecting particle density in the slurry). Additionally, Kilham discloses that the video camera may also convert the optical image into electronic form for viewing on a video monitor, which displays an

image for viewing by an observer to determine the size and density of particulate matter in the slurry (Col. 6, lines 46-51) and that providing additional viewing capabilities will help overcome problems with other types of sensors, such as difficulty in determining whether particulate matter consists of one particle or groups of particles (Col. 1, lines 41-45). Therefore, it would have been obvious to one of ordinary skill in the art that the sensor of Kondo may be replaced by the photo image sensor disclosed by Kilham, as known equivalents in the art, both being capable of detecting particle size, type and density in a slurry flow, and further to display the image on a video monitor to allow an observer to monitor the flow in addition, to determine size and density of the particulate matter in the slurry and to accurately determine whether particulate matter consists of one particle or groups of particles, as taught by Kilham. It would further be obvious that the enhancement and analysis computers disclosed by Kilham may replace the slurry measuring unit (arithmetic processing unit) of Kondo or may provide data to the slurry measuring unit and slurry flow control of Kondo to control the slurry supply unit of Kondo based upon the sizes and slurry density measured. Further, Kilham discloses that the thin layer of the slurry that is detected may be 3-dimensional, by having a thickness along the cross-section, thus, the particle density of the detected area will be determined in first, second and third dimensions, which does read on the applicant's claim limitation that the particle density of two dimensions is detected. Also, the thickness is a known value, so the particle density determined in 3-dimensions may easily be used to determine the particle density over two dimensions of the detected area by dividing by the thickness of the detected area.

4. In reference to claim 3, Kondo discloses that the diluent for the slurry production is pure water (paragraph 3, lines 1-3).

5. In reference to claim 5, the method of using the apparatus disclosed by Kondo would obviously provide a method to control slurry flow in a chemical mechanical polishing apparatus for planarizing an object to be polished by supplying slurry on a grinding pad through a slurry injection nozzle, the method comprising supplying slurry to the slurry injection nozzle through a slurry supply line, introducing slurry into a by-pass diverged from the slurry supply line, supplying a diluent solution into the by-pass to reduce a concentration of particles of the slurry, capturing with a photo image sensor (of Kilham) a cross-sectional image of the by-pass in which the slurry flows and displaying the sizes of particles included in the captured cross-sectional image and a particle density of the slurry across the cross-section of the by-pass (on the monitor disclosed by Kilham), analyzing the cross-sectional image captured by the photo image sensor to measure the sizes of particles included in the slurry and the density of the slurry across the cross-section of the by-pass, returning the slurry in the by-pass to the slurry supply line and controlling supply of the slurry based upon the measured sizes of particles and density of slurry.

6. In reference to claim 6, Kondo discloses that the diluent for the slurry production is pure water (paragraph 3, lines 1-3)

7. In reference to claim 7, it would be obvious that the density of the slurry supplied to the slurry injection nozzle would be higher than a density of the diluent solution because the slurry supplied to the slurry injection nozzle will have abrasive particles in

pure water, where as the diluent solution is only pure water and because the abrasive particles are made of solid material, it would further be obvious that the abrasive grains have a higher density than the pure water or water with a pH adjuster and would thus, make the slurry solution of pure water and abrasive grains have a higher density than the diluent solution.

8. In reference to claim 8, it would further be obvious that the amount of particles in the slurry supplied to the slurry injection nozzle will be higher than the amount of particles in the supplied diluent solution because the supplied diluent solution does not have any particles in it.

9. Claims 2, 3 and 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo et al (2002/0061722) in view of Kilham (5,191,388) and Grant et al (2003/0174306).

10. In reference to claim 2, Kondo and Kilham disclose the apparatus, as discussed supra, and suggest structure that would require that a diluent is supplied to the by-pass prior to passing through the sensor but does not specifically disclose a diluent supply that supplies diluent to the by-pass. Grant discloses a similar slurry control unit for monitoring and controlling slurry density and flow and teaches that when using optical particle sensors, similar to those used by Kondo or Kilham, to detect size and quantity of particles in slurry, the slurry must be diluted enough so that only one detectable particle passes through the light beam at a time (paragraph 11). Therefore, it would have been obvious, in view of the disclosures of Kondo and Grant, to one of ordinary



skill in the art at the time the invention was made to provide a means to further dilute the slurry solution prior to passing through the sensors to ensure that the sensors can obtain accurate readings. It would further have been obvious that the means to further dilute the slurry solution will be a diluent solution supply unit and to provide the diluent solution supply unit directly to the by-pass prior to the sensor(s). It would have been obvious to provide the diluent solution supply unit directly to the by-pass because a smaller amount of diluent solution would need to be added to the slurry solution in the by-pass than would need to be added to the slurry solution in the slurry supply line to sufficiently dilute the slurry solution that is passing through the sensor to desired amount. Supplying the smaller amount of diluent solution to the slurry in the by-pass will reduce expense of providing the diluent solution and will also serve to better maintain the desired composition of the slurry that is in the slurry supply line that is delivered to the injection nozzles by minimizing the additional diluent added to the entire system. Again it would have been obvious to replace the sensor of Kondo with the photo image sensor of Kilham, as known equivalents in the art, which would provide a predictable result and to provide a video monitor to display the particle sizes and particle density in the slurry, as taught by Kilham.

11. In reference to claim 3, Kondo discloses that the diluent for the original slurry production is pure water (abstract, lines 1-3) and Grant further discloses that the diluent can be several different types of water including pure water. Thus, it further would have been obvious that the diluent solution provided to the by-pass could be pure water.

12. In reference to claim 5, the obvious combination of Kondo, Kilham and Grant would provide a method to control slurry flow in a chemical mechanical polishing apparatus for planarizing an object to be polished by supplying slurry on a grinding pad through a slurry injection nozzle, the method comprising supplying slurry to the slurry injection nozzle through a slurry supply line, introducing slurry into a by-pass diverged from the slurry supply line, supplying a diluent solution into the by-pass to reduce a concentration of particles of the slurry, capturing with a photo image sensor (of Kilham) a cross-sectional image of the by-pass in which the slurry flows and displaying the sizes of particles included in the captured cross-sectional image and a particle density of the slurry across the cross-section of the by-pass (on the monitor disclosed by Kilham), analyzing the cross-sectional image captured by the photo image sensor to measure the sizes of particles included in the slurry and the density of the slurry across the cross-section of the by-pass, returning the slurry in the by-pass to the slurry supply line and controlling supply of the slurry based upon the measured sizes of particles and density of slurry.

13. In reference to claim 6, Kondo discloses that the diluent for the original slurry production is pure water (abstract, lines 1-3) and Grant further discloses that the diluent can be several different types of water including pure water. Thus, it further would have been obvious that the diluent solution provided to the by-pass could be pure water.

14. In reference to claim 7, it would be obvious that the density of the slurry supplied to the slurry injection nozzle would be higher than a density of the diluent solution because the slurry supplied to the slurry injection nozzle will have abrasive particles in

pure water, where as the diluent solution is only pure water or water with a pH adjuster and because the abrasive particles are made of solid material, it would further be obvious that the abrasive grains have a higher density than the pure water or water with a pH adjuster and would thus, make the slurry solution of pure water and abrasive grains have a higher density than the diluent solution.

15. In reference to claim 8, it would further be obvious that the amount of particles in the slurry supplied to the slurry injection nozzle will be higher than the amount of particles in the supplied diluent solution because the supplied diluent solution does not have any particles in it.

### ***Response to Arguments***

16. Applicant's arguments filed 12/20/2007 have been fully considered but they are not persuasive. The applicant argues that neither Kondo nor Kilham teach or disclose that the particle density of *two dimensions* of the slurry is detected. However, the sensor of Kondo does detect the density of a cross-section of the by-pass, which would inherently be the particle density of two dimensions. Further, as discussed above and pointed out by the applicant in the arguments, Kilham does disclose that the detected area is 3-dimensional and that the particle density of this area may be detected. However, a detection of particle density in a 3-dimensional area, does read on the applicant's limitation that the particle density of two dimensions of the slurry is detected, because the detection of the 3-dimensional area clearly detects at least two dimensions.

Further, as discussed supra, the thickness of the detection area is a known value, so the actual two dimensional particle density of a portion of the area may be determined merely by dividing the particle density of the 3-dimensional area by the known thickness.

### ***Conclusion***

17. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Farkas et al (5,710,069) discloses an apparatus for monitoring and controlling slurry using a photo image sensor, Cerni et al (6,275,290) discloses an apparatus for monitoring and controlling slurry that comprises a by-pass with a photo image sensor to detect a cross-sectional image of the slurry in the by-pass, Kilham (5,191,388) discloses a photo image sensor apparatus for analyzing particulate matter in slurry flow, Choi et al. (2003-036970) discloses a method for measuring density and particle size in a slurry using ultraviolet light, Lawton (6,347,976) discloses a common CMP system the uses sensors to determine operating properties of the system to control the system and uses a nozzle to supply the slurry to the substrate.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRYAN R. MULLER whose telephone number is (571)272-4489. The examiner can normally be reached on Monday thru Thursday and second Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph J. Hail III can be reached on (571) 272-4485. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Bryan R Muller/  
Examiner, Art Unit 3723  
3/31/2008